UNITED STATES ATOMIC ENERGY COMMISSION

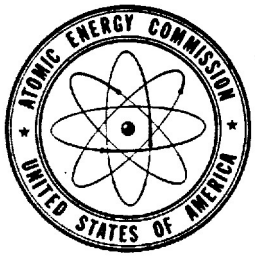
Annual Report to Congress

OF THE

ATOMIC ENERGY COMMISSION

FOR

1962-64



January 1963

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON, D.C

LETTER OF SUBMITTAL

WASHINGTON, D.C.,
30 January 1963.

SIRS: We have the honor to submit herewith the Annual Report of the United States Atomic Energy Commission for 1962 as required by the Atomic Energy Act of 1954.

Respectfully,

UNITED STATES ATOMIC ENERGY COMMISSION,
LELAND J. HAWORTH.
JOHN G. PALFREY.
JAMES T. RAMEY,
ROBERT E. WILSON.
GLENN T. SEABORG, *Chairman.*

The Honorable
The President of the Senate.
The Honorable
The Speaker of the House of Representatives.

• The nuclear powered, guided missile cruiser *Long Beach* operated with the Atlantic Fleet early in 1962 to evaluate her nuclear propulsion plant. During these operations, she visited Europe and traveled a total of 39,029 miles. Following these operations, the *Long Beach* entered the Philadelphia Naval Shipyard where installation of her weapons system is scheduled for completion early in 1963.

• The aircraft carrier *Enterprise* completed her first full year of operations in 1962. These operations included deployment to the Caribbean during the Cuban crisis and operations with the Sixth Fleet in the Mediterranean.

• On August 2, the nuclear submarines *Skate* and *Seadragon* met at the North Pole, having traveled submerged from New London, Conn., and Pearl Harbor, Hawaii, respectively.

• As of December 31, 1962, nuclear-powered Navy ships had traveled approximately 2¼ million miles.

Nuclear Safety Program

• A series of short-period tests in which a SPERT–1 reactor core was intentionally damaged were completed during the year. These tests were part of a series which terminated in an intentional 3.3 millisecond period excursion in which the core was destroyed on November 5.

• A series of tests and experiments was initiated to ascertain the effectiveness and validity of the features designed into the SNAP systems to assure their safety under prelaunch, launch, preorbital, and postorbital conditions.

• The nuclear safety program for both terrestrial and aerospace reactor systems was expanded to include engineering field reliability and safety tests of nuclear components and systems. Responsibility for conducting these tests has been assigned to the Phillips Petroleum Co. (terrestrial) and the Sandia Corp. (aerospace).

Part Three—Production and Weapons Programs

Raw Materials Program

• Uranium concentrate deliveries totaled 28,690 tons of uranium oxide (U_3O_8) during 1962, of which 17,010 tons were from domestic suppliers, 7,410 tons from Canada, and 4,270 tons from overseas.

• The Commission's program of guaranteed prices for ore and individually negotiated mill concentrate prices expired March 31, 1962. It was superseded by the present 1962–66 procurement program, under which the Commission purchases uranium in the form of acceptable concentrates at an established price of $8 per pound of U_3O_8. The

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ore-buying program had been in effect since April 1948, and during this period domestic uranium production increased from less than 100 tons of U_3O_8 per year to in excess of 17,000 tons; ore production expanded from approximately 15,000 tons a year to more than 8 million tons; and ore reserves increased from about 3 million tons to over 80 million tons. Twenty-four privately owned uranium mills were operating in 1962 as compared with two in 1948.

- On November 17, the Commission announced a "stretchout" program for domestic uranium procurement for the 1967–70 period. The new program consists of a deferral to 1967–68 of a portion of the uranium now contracted for delivery to the AEC before 1967 and the purchase, between 1969–70, by the AEC of an additional quantity equal to the amount deferred. This will assure uranium producers of a market until the anticipated requirements of private power reactors are more firmly established.
- The Commission announced in June that it was relaxing production limitations on small domestic mining properties having production allocations of less than 20,000 pounds of U_3O_8 in ore per year. Effective April 1, 1962, uranium mills have been allowed to contract for the purchase of up to 10,000 pounds of U_3O_8 in ore per half year from individual mining properties with allocations of this amount or less subject to an overall ceiling of 1 million pounds U_3O_8 per year.

Production

- Reductions in unit operating costs were achieved in the production complex when refinery operations were consolidated at Weldon Spring, Mo., and the refinery at Fernald, Ohio, was placed on a standby basis. The plant for conversion of uranium to hexafluoride at Portsmouth, Ky., was also placed in standby early in 1962.
- On December 13, a chemical explosion and the ensuing fire caused $2 million damage to the AEC's Paducah, Ky., gaseous diffusion plant. There were no personnel injuries and no radiation hazard.
- Nuclear Fuel Services, Inc., a subsidiary of W. R. Grace & Co., submitted a proposal to construct and operate a spent fuel reprocessing plant; no private capability for this service currently exists.
- The Commission negotiated a tentative agreement with the Washington Public Power Supply Systems (WPPSS) for construction and operation of electricity producing facilities at its Hanford, Wash., plant as permitted, under specified conditions, by recent Congressional authorization. The WPPSS facilities will use heat drawn from the New Production Reactor (NPR) now under construction; the 800,000 electrical kilowatt generating facility will be the largest nuclear-electrical power installation in the world.

Radioactive Wastes Management

- About 69,000 cubic feet of radioactive waste materials were received from licensees for burial at Commission-owned sites; a total of 2,359,000 cubic feet of Commission-generated and licensee material was buried in fiscal year 1962.
- A long-term study of low-level radioactive waste disposal operations at three Pacific Ocean sites by a National Academy of Science-National Research Council Committee has shown that no radioactive hazard has been created, and that under present procedures an additional 40 sites could be established with safety. The Commission, however, does not plan to establish more ocean disposal sites for use of licensees. In fact, ocean disposal has been declining because of economic factors.

Military Application

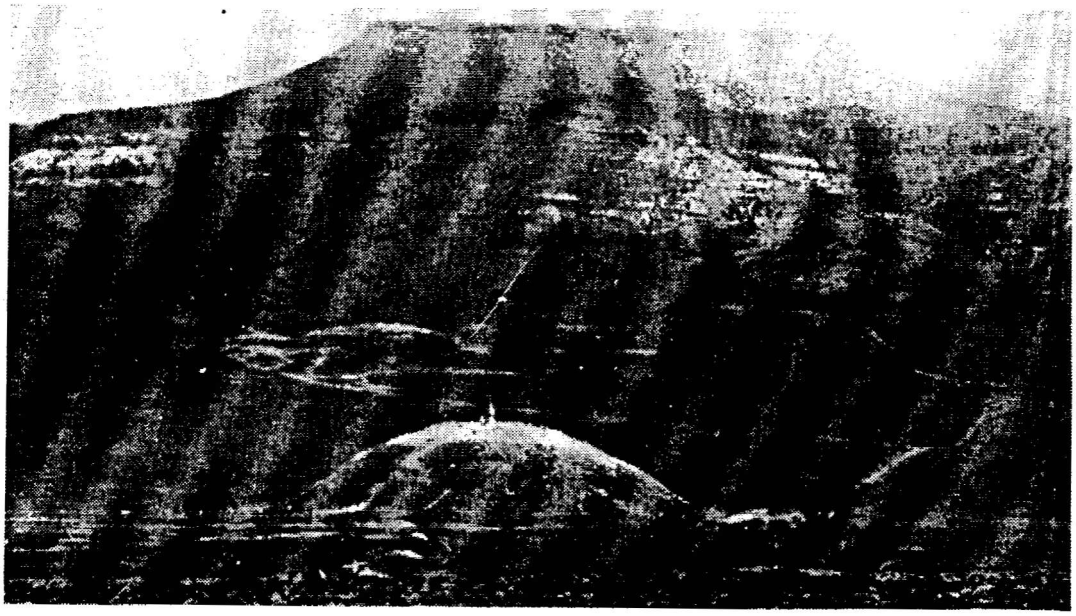
- The underground nuclear tests at the Nevada Test Site were continued. As of December 31, 1962, a total of 61 weapons test events in Nevada had been announced for the year, including two test detonations conducted at the Nevada Test Site for the British.
- An atmospheric test series was conducted in the Pacific, with operations based on Christmas Island and Johnston Island. A total of 36 nuclear events were announced during the series which was concluded on November 4, 1962.
- Plans proceeded in conjunction with the Department of Defense, for three nuclear detonations in a salt dome in Mississippi and one nuclear detonation in an active seismic area in Nevada, to increase the capabilities of detecting and identifying underground nuclear explosions. The detonations have not yet been authorized.

Part Four—Other Major Programs

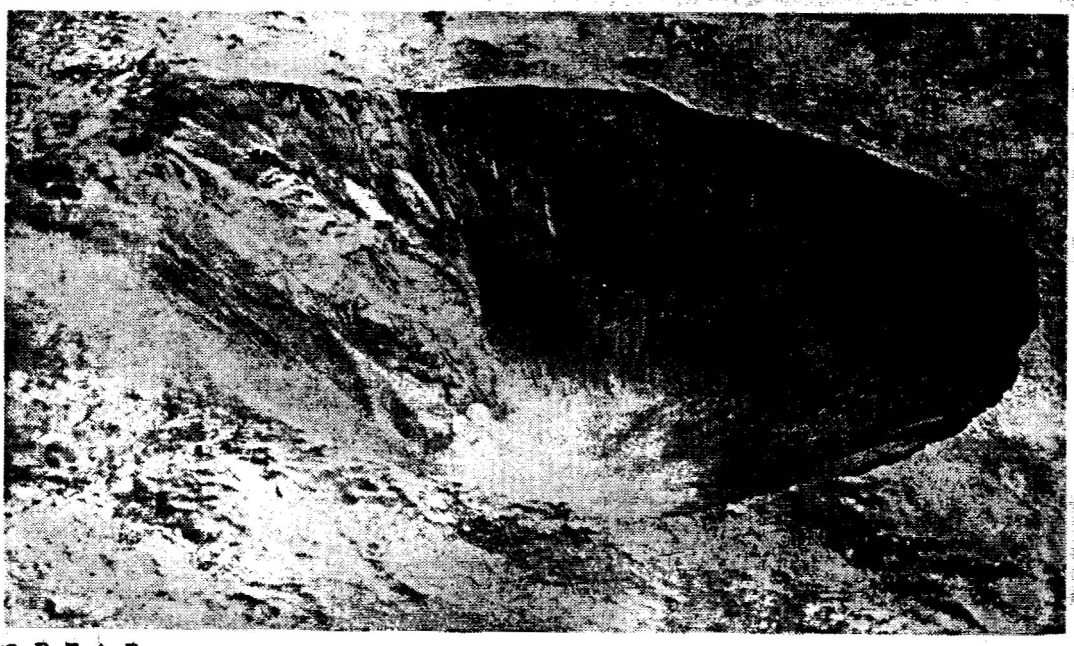
Plowshare Program

- Within the Plowshare program, in which peaceful uses for nuclear explosives are being developed, a goal of developing nuclear excavation technology within about 5 years was established during 1962 and an experimental program has been planned to reach this goal.
- On July 6, the development necessary for the use of nuclear explosives as an accepted engineering tool took a major step forward when the Commission successfully conducted Project Sedan in the

desert alluvium of the Nevada Test Site. Project Sedan was a 100-kiloton cratering experiment and the first of the experiments planned in the 5-year developmental program referred to above.



Project Sedan. First major nuclear excavation experiment of the Commission's Plowshare program was Project Sedan which was detonated 635 feet under the Nevada Test Site desert on July 6, 1962. The 100 kiloton thermonuclear explosive created a ground surge three seconds after detonation resembling a hemispherical dome 600 to 800 feet in diameter and 290 feet high. Photo *above* shows the earth "bubble" just before it was split open by incandescent gases. Photo was taken from a distance of three miles. Air view, photo *below*, shows the crater, about 1,280 feet across and 320 feet deep, that resulted from the explosion. The lip of the crater varies from 20 to 100 feet in height. About 7.5 million cubic yards of earth and rock were moved in this demonstration of how nuclear explosives can be used in large-scale excavation projects such as digging harbors and canals.



• Site preparation was begun for Project Coach which is being planned for the site of the 1961 Project Gnome experiment. Project Coach, conduct of which has not yet been authorized, would be a scientific experiment to study the feasibility of using a nuclear explosive to produce neutron-rich isotopes of known transplutonium elements and, possibly, of elements heavier than those yet discovered.

Radioisotope Development

• During the past year an Isotopes Development Center was established at Oak Ridge National Laboratory to serve as a focal point for the development of radioisotope technology and for continued evaluation of radioisotope developments on a worldwide basis.

• A Radiation Development Center has been established at Brookhaven National Laboratory to serve as a focal point for Commission research and development activities related to the use of high intensity radiation sources as a processing tool.

• Production and sales of radioisotopes attained record levels in 1962 as 515,637 curies of radioisotopes were distributed and $2.8 million in sales were achieved. Oak Ridge National Laboratory made over 169,000 radioisotope shipments in the 16-year-old radioisotopes distribution program.

• The world's largest single cobalt 60 source, 1,290,000 curies, was produced at Savannah River for use in the Quartermaster Food Irradiation Research Laboratory at Natick, Mass., now completed by the AEC and formally turned over to the Department of the Army.

• The development of a radioisotope method for precisely measuring residual amounts of agricultural insecticides left on foodstuffs is contributing to increased protection of the health of the American public.

• Superior quality materials, made through the irradiation of plastic-impregnated wood, exhibit an increase in hardness, dimensional stability, and improved compressional strength.

• The application of neutron activation analysis to problems in criminology has opened up an area of unprecedented sensitivity in the law enforcement area.

• In a cooperative program with NASA, devices using radioisotopes are being developed to analyze the composition and density of the atmospheres of the planets.

• Significant achievements have been made in the technology for radiation pasteurization of foods, including the delineation of processing conditions to insure the retention of freshness and nutritional values of certain fish and fruit products.

Production of uranium hexafluoride (UF_6) is accomplished at the Commission's plants at Paducah, Ky., (UO_3 to UF_6), Weldon Spring, Mo., (UO_3 to U_3O_8), and at the privately owned Allied Chemical plant. Enrichment of normal UF_6 with the uranium 235 (U–235) isotope is now accomplished only in Government owned gaseous diffusion plants at Oak Ridge, Tenn., Paducah, Ky., and Portsmouth, Ohio.

Uranium processing. Industrial capacity exists today to convert normal, depleted, and enriched UF_6 to metal and various uranium compounds. However, very few of the processors are producing at or near their capacities. Private capability and competition in the processing of uranium appear adequate for industry needs.

Although future needs for processing services in the licensee program are expected to decline over the next few years, military and space requirements are expected to increase, thus resulting in a net increase in work for this segment of the industry over the next several years.

Almost all uranium metal for use in the production-weapons program, the Naval program, and for test reactors at the National Reactor Testing Station, Idaho, is produced in AEC facilities. The industrial and non-production-weapons program needs for metal have been declining and are expected to continue to decline over the next several years.

Unlike uranium metal, almost all uranium oxide is produced in privately owned facilities. The demand for oxides and other compound forms is increasing and may continue to increase over the next several years.

Nine firms have capability for converting UF_6 to forms needed for fabrication of fuel elements.[10]

Commercial conversion of UF_6. For the past 4 years, nearly all enriched uranium provided for nonproduction/weapons uses has been supplied as uranium hexafluoride (UF_6) for further processing in commercial plants. In 1956 all uranium for nonproduction/weapons uses had to be processed beyond the hexafluoride stage in Commission facilities. The growth of commercial capability in this segment of the industry is reflected year-by-year in the following table.

[10] The nine firms are (italicized indicates a licensed facility): Coors Porcelain Co., Golden, Colo.; *Davison Chemical Co., Erwin, Tenn.;* General Dynamics Corp., San Diego, Calif.; Minnesota Mining & Manufacturing Co., St. Paul, Minn.; National Carbon Co., New York, N.Y.; National Lead Co., Albany, N.Y.; *Nuclear Materials & Equipment Corp., Apollo, Pa.; Spencer Chemical Co., Pittsburg, Kansas* (Nuclear operations of Spencer have recently been taken over by Kerr-McGee.); *United Nuclear Corp., Hermatite, Mo.* (Unlicensed facilities do conversion work only under contract to the AEC.)

ENRICHED URANIUM FURNISHED TO INDUSTRY

	Fiscal years (kilograms of uranium)						
	1956	*1957*	*1958*	*1959*	*1960*	*1961*	*1962*
Furnished as UF_6	0	6,000	24,000	110,300	86,200	118,400	125,600
Furnished* in forms other than UF_6	2,400	4,000	21,000	6,300	3,400	6,900	3,000
TOTAL	2,400	10,000	45,000	116,600	89,600	125,300	128,600

*Primarily for AEC programs.

Fabrication of uranium fuel elements. Seventeen firms [11] produce various types of fuels and shapes from metal and compounds, including newer types. In general, the fabrication field is highly competitive with a number of fabricators utilizing a high percentage of their capacities.

Quantities of uranium utilized outside of the production-weapons field have been steadily increasing. Although this trend is expected to continue, changes in the firms in this field due to competition and changing fuel types may be expected.

AEC orders for fuel from industry. Orders placed by the Commission on commercial suppliers of fuel in the 1962 fiscal year were nearly double the value of such orders placed in the prior fiscal year and were substantially above those placed in any earlier year.

AEC ORDERS FOR NUCLEAR FUEL FROM COMMERCIAL SUPPLIERS

	Fiscal year (millions of dollars)			
Orders placed for:	*1959*	*1960*	*1961*	*1962*
Naval purposes	$38.6	$48.6	$29.2	$60.9
All other purposes	2.8	3.8	4.0	4.5
TOTAL	41.4	52.4	33.2	65.4

Thorium, U–233, plutonium. Present needs for these materials for peaceful uses are very limited and essentially of a developmental nature. Nonetheless, thorium is processed by seven firms [12] and can be fabricated in facilities which can fabricate uranium.

[11] The 17 firms in the uranium fabrication area are (italicized indicates a licensed facility): *Aerojet-General Nucleonics, San Ramon, Calif.;* Atomics International, Canoga Park, Calif.; *Babcock & Wilcox Co., Lynchburg, Va.; Battelle Memorial Institute, Columbus, Ohio; Carborundum Co., Niagara Falls, N.Y.; Combustion Engineering, Windsor, Conn.; Davison Chemical Co., Erwin, Tenn.; General Dynamics Corp., San Diego, Calif.; General Electric Co., San Jose, Calif.; Martin-Marietta Co., Baltimore, Md.; Metals and Controls, Inc., Attleboro, Mass.; National Lead Co., Albany, N.Y.; Nuclear Materials & Equipment Corp., Apollo, Pa.; Nuclear Metals, Inc., Concord, Mass.; Sylvania Electric Products, Inc., Hicksville, N.Y.; United Nuclear Corp., New Haven, Conn.; Westinghouse Electric Corp., Pittsburgh, Pa.*

[12] The principal firms processing thorium are: American Potash & Chemical Corp., West Chicago, Ill.; Davison Chemical Co., Erwin, Tenn.; Dow Chemical Co., Midland, Mich.; Metal Hydrides, Inc., Beverly, Mass.; National Lead Co., Albany, N.Y.; United Nuclear Corp., Hematite, Mo.; Vitro Corp. of America, New York, N.Y.

Uranium 233 (U–233) can be processed by Davison Chemical Co., Erwin, Tenn., and can be fabricated by Atomics International, Canoga Park, Calif. Babcock & Wilcox is currently erecting a facility at Lynchburg, Va., which will have both laboratory and pilot plant capabilities for working with U–233.

Plutonium can be processed and fabricated to a limited extent by Nuclear Materials and Equipment Corp., Apollo, Pa., and can also be fabricated by United Nuclear Corp., White Plains, N.Y., and Battelle Memorial Inst., Columbus, Ohio. In addition, Monsanto Research Corp., Dayton, Ohio, and Nuclear Materials and Equipment Corp., Apollo, Pa., have facilities for the fabrication of plutonium-beryllium neutron sources, alpha sources, threshold detectors, and the like. The Carborundum Co., Niagara Falls, N.Y., has filed an application for a license covering the pelletizing of both plutonium and uranium carbide into ceramic type fuel.

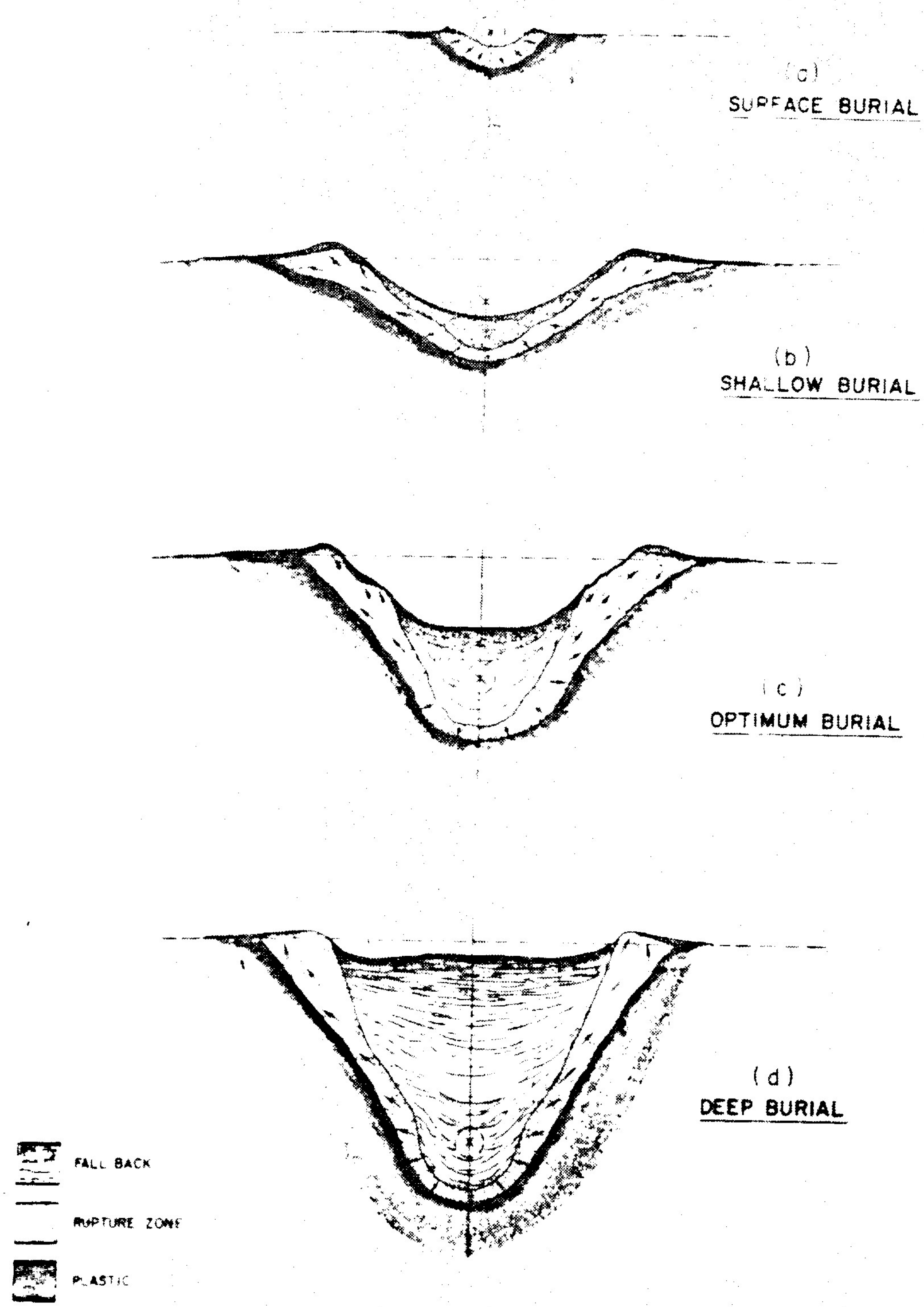
Nonfuel materials. Generally, private industrial capacity exists for the production, processing and fabrication of the various nonfuel materials associated with atomic energy work (*i.e.*, control materials; moderator and reflector materials; coolants; cladding and matrix materials; and shielding materials).

A few materials, boron 10, enriched lithium 6 and 7, and heavy water are produced only in Government-owned facilities. The feasibility of obtaining boron 10 from private industry is now under study. A complete evaluation of the industry has not been attempted in the nonfuel materials area since, for the most part, this segment of industry is not primarily dependent upon atomic energy work.

Beryllium. Representatives of seven commercial organizations interested in beryllium production and fabrication met with the Commission's staff in October for an exchange of information to assist the industry in its advance planning. AEC programs and estimates of AEC requirements were presented, forms in which beryllium is needed and critical specifications were discussed, AEC plans to utilize beryllium scrap were explored, and the AEC research and development effort in the beryllium field was described. Similar meetings (on this or other subjects) are expected to be held in the future whenever a need arises for such an exchange of information.

Nuclear Components and Equipment (Category 3)

All nuclear components and equipment are now available commercially, and there is no substantial competition between AEC and private industry in furnishing items falling within this category.



Crater Profiles. The characteristics of craters produced with explosives vary with the depth of burial of the explosive as well as the type and power of the explosive. Drawing above shows typical crater profiles vs depth of burst in alluvium soil. In general, the craters are wider and shallower at deeper depths of burst.